FIRE MANAGEMENT NOTES

WINTER 1977-78 Volume 39, Number 1

U.S. DEPARTMENT OF AGRICULTURE • FOREST SERVICE

FIRE MANAGEMENT NOTES

An international quarterly periodical devoted to forest fire management

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THE COVER

The tundra burns! In 1977 Alaska recorded its third worst fire season in 20 years. Over 2.9 million acres were burned, yet no lives were lost and no serious injuries were incurred. This issue's lead article explains what happened and how the problem was attacked.

FIRE MANAGEMENT

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Bob Bergland, *Secretary of Agriculture*

John R. McGuire, *Chief, Forest Service*

Henry W. DeBruin, *Director, Aviation and Fire Management*

J.O. Baker, Jr., *Managing Editor*

Alaska Fire Season — 1977

Fred E. McBride

The 1977 fire season in Alaska was the third worse season in the past 20 years as indicated by the fire weather, the fire behavior, and the number of fire ignitions. During the early part of the season the weather trends did not follow the historic patterns that would allow for short term warning of the change which was to occur. Fire behavior was extreme, and only 1972 and 1974 exceeded 1977 in the number of fire ignitions.

During the year, there were over 680 fires, which burned more than 2.29 million acres. Only 42 of these fires escaped initial suppression efforts; however, these escape fires accounted for more than 2.2 million acres burned.

Fire Weather

The fire situation was caused by a complete reversal of weather conditions in late June and early July (fig. 1 and 2). In the spring precipitation ranged from 100 to 200 percent of normal. Even on the Seward Peninsula, where the majority of the large fires occurred (fig. 3), the departure above the normal anticipated precipitation was 125 percent. However, in June the precipitation was only 25 percent of the normal, and by July is ranged between 10 and 30 percent of the normal amount that was expected.

Temperature followed the same trend as rainfall. The May average deviation from the normal temperature was –3° F. on the Seward Peninsula. June temperatures were normal, but by July they had risen to an average of 10° F. above normal.

By midsummer the weather reversal was complete. During July and August little precipitation occurred over the

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Alaska Precipitation Patterns
May - July 1977

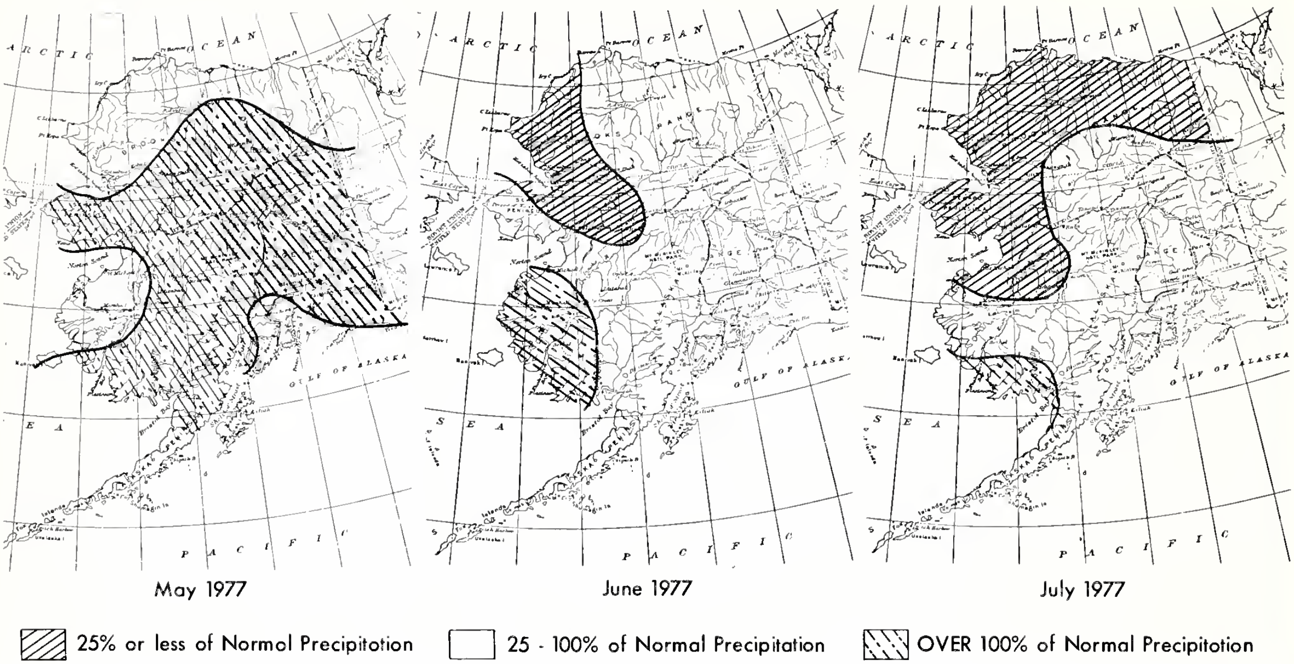

Figure 1. — Much of Alaska received above normal amounts of precipitation in May, 1977. But this trend changed dramatically in June and July.

interior of Alaska. The storm track, moving south along Kodiak Island and the Gulf of Alaska coast, allowed only 30 to 60 percent of the normal rainfall in the interior in July. Moisture did not fall in the interior, even though weather forecasts repeatedly idicated it would do so. The drying trend spread over the eastern interior during August.

Fire Ignitions

The most important phenomenon, in regard to the weather, was the rapidity of the change that occurred. The entire area was cool and moist in May, yet one month later it was dry and hot.

Fire ignitions were exceptionally high in the areas where, due to changed weather patterns, the fuel moisture was low. Although some fires occurred early, no problems seemed to develop. Then in June some indicators of trouble began to appear. On June 11, a lightning storm caused multiple-fire ignitions. One of these fires, 10 miles southwest of Nenana, had a rapid rate of spread and burned 1,200 acres.

Significant changes began to occur in early July. On July 8, the first problem occurred when Pump Station 8 of the Alaskan Pipeline exploded. The Bureau of Land Management was called upon to extinguish the resulting wildland fire and to provide emergency medical treatment.

Fire Behavior

Indicators of extreme fire behavior were isolated during May and June, but by July most fire bosses were reporting erratic fire behavior and extreme fire intensities. An excerpt from the July 31 situation report illustrates what was occurring in vivid terms.

July 31, 1977

- **62 fires burning; 12 manned and contained; 25 manned and still out of control; 3 unmanned and contained; and 22 unmanned and out of control. Ten fires extinguished today.**

The report continued to give the status on the fires over 100 acres in size. The following was reported:

- **8657 — Kaiyak — 30,000 acres, crews are working on the line on the east side, the north side is hot.**
- **8818 — OTZN90 — 1,000 acres being mopped-up**
- **8623 — Kugruk Hi — 320,000 acres; 14 miles have been backfired; the southwest sector and the west sector are smoked in.**
- **8673 — BTTW47 — 3,000 acres.**
- **8705 — Kiliovil — 110,000 acres; fire is backing into the wind on the north side at 10 chains per hour. Crews are defending village structures on the north flank.**

Mr. McBride is Fire Management Branch Chief within the Division of Fire and Protection Management, Bureau of Land Management, Washington, D.C.

Alaska Temperature Patterns
May - July 1977

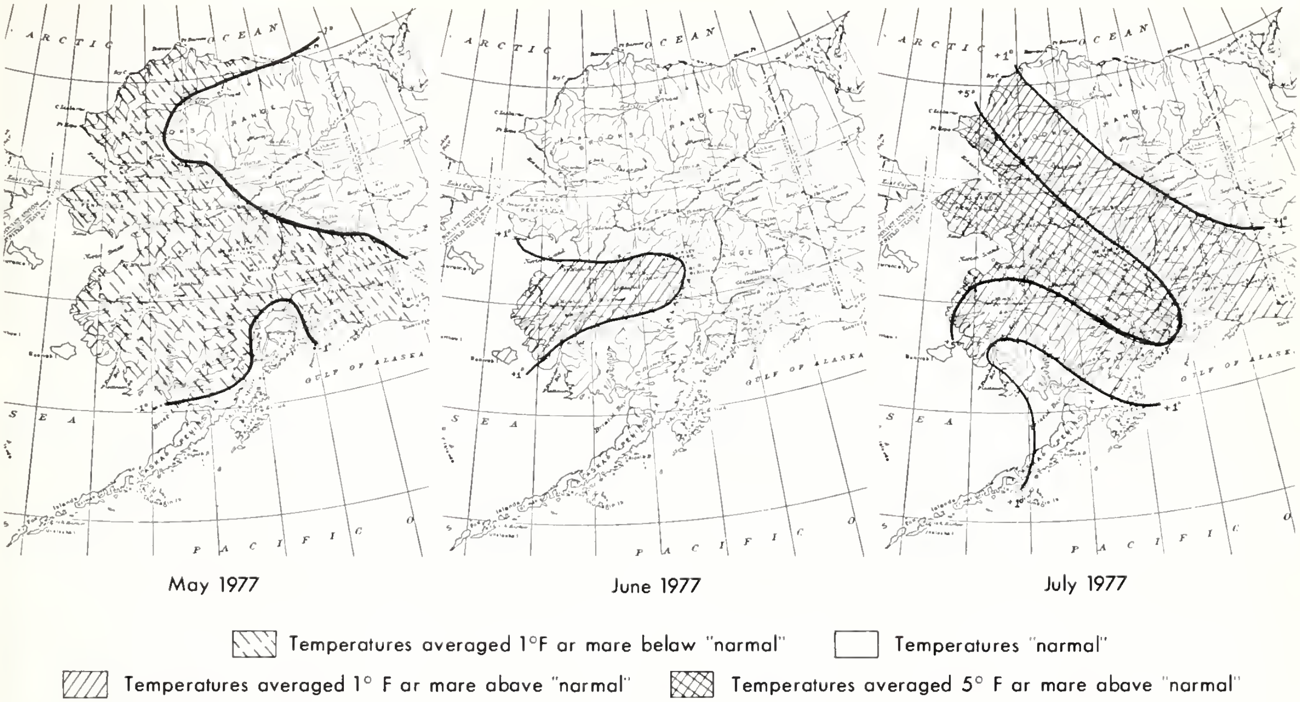

Figure 2. — Temperature deviations likewise showed a dramatic shift between May and July.

- **8780 — GMTS12 — 1,200 acres; smoke is hampering logistics operations.**
- **8769 — Crow Lake — 45,000 acres; burning on all sides; extreme temperatures and burning conditions; entire area is smoked in.**

Six additional fires were manned but uncontained on that day. Each fire boss reported high to extreme burning conditions and high rates of spread. Many reports showed crews were smoked in and/or fighting defensive actions around village structures. Eighteen additional fires were unmanned and uncontained. Extreme fire behavior was occurring on all these fires, but none of the 18 were threatening villages.

The extreme fire behavior can best be illustrated by what happened on the Pah River Fire. The July 30 report showed the fire had burned 200 acres, but by July 31 the fire had grown to 20,000 acres. The average forward rate of spread was a 150chains-per-hour increase in the 24 hour period.

Initial Attack Success

Although over 2 million acres burned on 42 project fires, Alaska firefighters set records for initial attack success. Initial attack and first backup forces controlled 93.3 percent of the total ignitions. This success, in light of the extreme conditions and the remote locations of most fires, was a tribute to the members of the Alaska fire suppression organization. The total acreage loss in these 639 fires was approximately 10,000 acres. Increased forces, air tanker capacity, and aerial firing can be credited with much of the savings.

Force Deployment

During 1977 BLM expanded its Alaska initial attack capability because of the increased fire activity. Forces were called in from other agencies in Alaska, from other States, and from the villages throughout Alaska.

Based on a total mobility plan used in Alaska during the past few years, forces were deployed to areas receiving unusually high fire ignitions. General headquarter operations were established to control areawide fire problems, and actions in the assigned areas were coordinated through these offices. Overhead personnel were deployed from other States, and Boise Interagency Fire Center specialty crews were flown in to assist the action.

An idea of the magnitude of the

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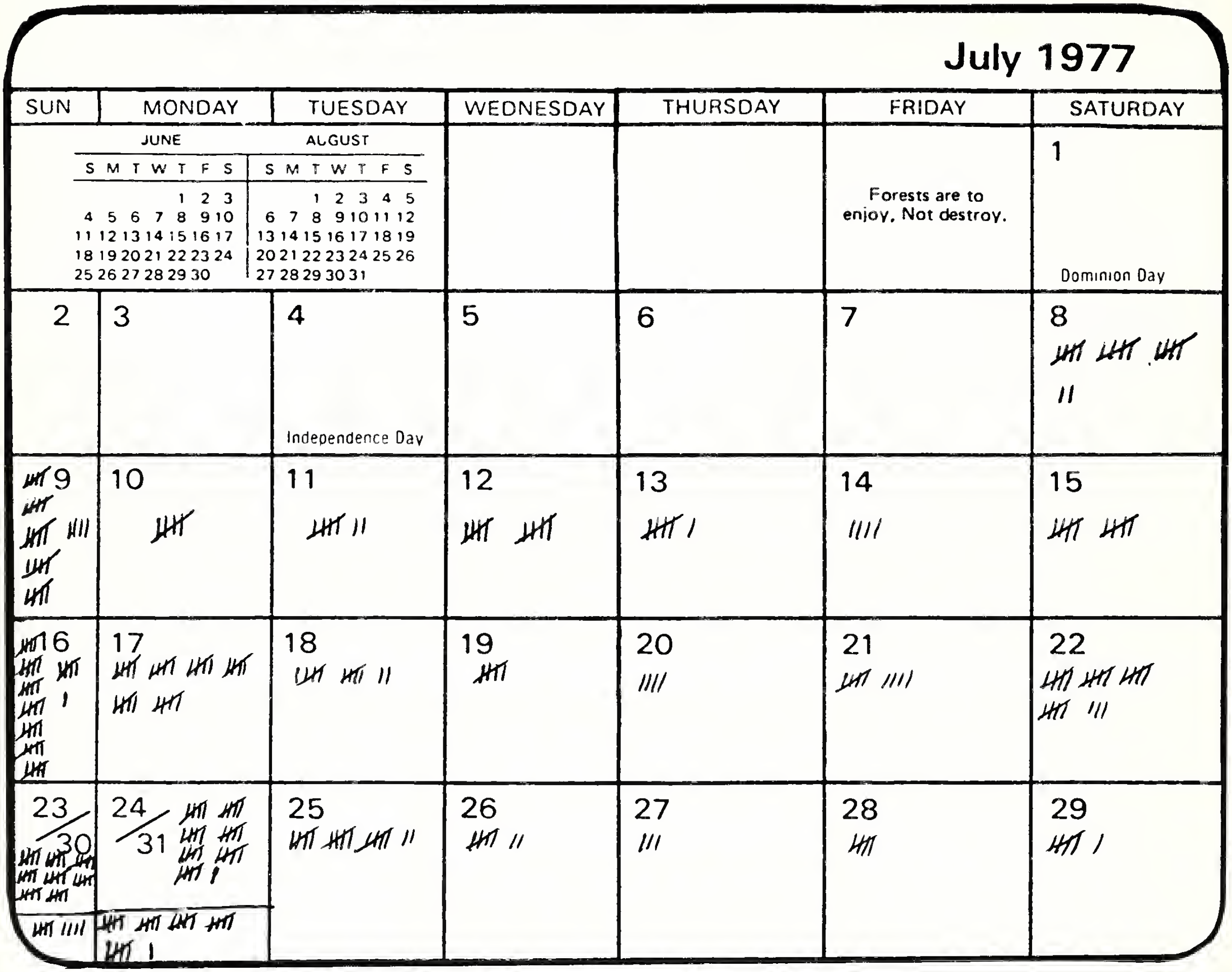


Figure 3.—**The new fires, tallied on a calendar on the day they started, show the increasing magnitude of the problem fire managers faced.**

1977 fire suppression operation can be obtained from Table 1.

Decisionmaking for Resource Damage

The Alaska BLM fire mangement organization should be highly praised for implementing an outstanding operational resource damage appraisal and attack planning system during this disastrous situation. Throughout the fire season, the Alaska fire managers utilized resource impact advisory groups to assess the potential damage of various suppression alternatives. The groups were an assembly of line officers, resource specialists, special interest groups, and local people. They reviewed the fire behavior and assessed the potential damage of the fire suppression alternatives. The groups worked with BLM State Office officials and with the plans sections of the fire operations. The plans chiefs used the information obtained from these groups to set suppression priorities.

Summary

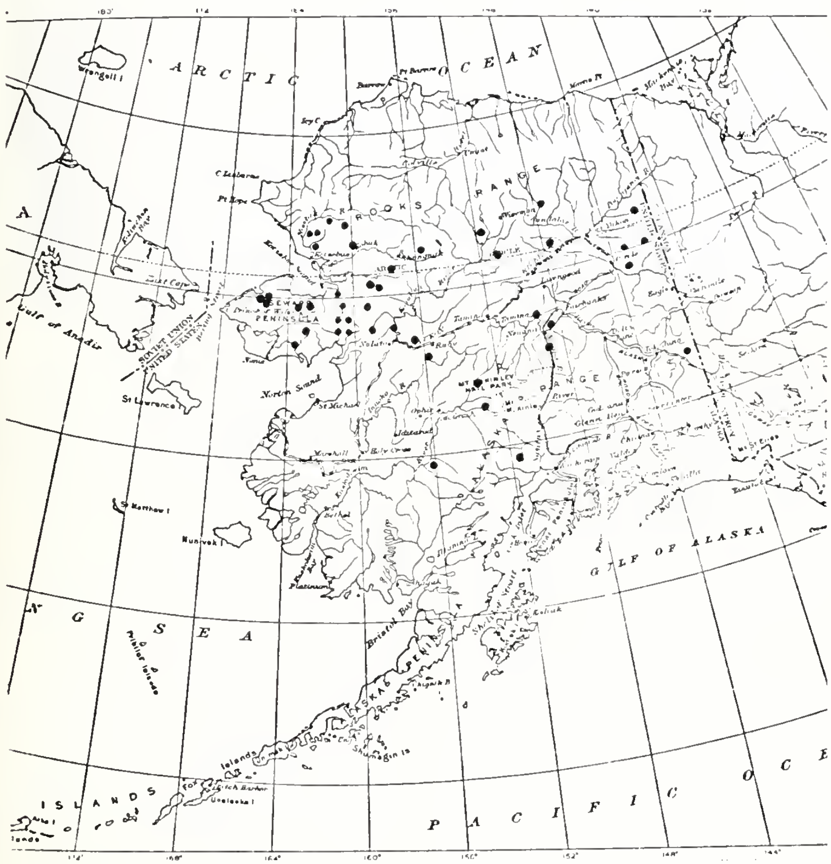
Alaska was faced with the third worse fire season in the past 20 years. The weather change which occurred was a complete reversal of early wet, cool conditions to high temperatures and extreme dry conditions. Fire behavior was extreme on most fires that occurred in July and August, yet 93.3 percent of all fires were controlled by initial attack and first support personnel. Only 42 fires escaped initial control efforts, yet

Aircraft use (flight hours)	**24,088**
Retardant dropped (gallons)	**1,930,300**
Smokejumper activities	
Number of jumpers	
BLM Alaska	**68**
Forest Service	**85**
Fire attacked by smokejumpers	
Initial attack	**291**
Reinforcement	**136**
Initial attack jumps made	**1,320**
Emergency firefighters (hours worked)	**1,408,000**
Cargo transported (tons)	
Ground vehicles	**703**
Aircraft	**6,055**

Table 1. — Summary of some fire suppression functions that took place in Alaska in 1977.

these fires accounted for over 2.2 million acres burned.

Fire suppression forces were increased from other agencies, local population centers, and other States. Damage advisory groups were employed to assess the potential damage on fires and to advise fire control personnel on the potential damage of various alternative methods.



Approximate location of fires over 300 acres

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Boise Interangency Fire Center Experiences a Long, Hot Summer

Arnold Hartigan

Summer started early and continued hot for the fire support personnel at the Boise Interagency Fire Center. Hot weather and low humidity, compounded by tinder-dry conditions caused by 2 years of drought in many parts of the country, created extreme fire conditions in several States in 1977.

The Palmer Drought Index, a relative measure of drought severity, serves to bring last summer's situation into focus. With numerical readings ranging from "+4" for extremely high moisture levels to "–4" for the lowest indicator of severe drought, the Palmer Drought Index had negative readings ranging from –5 to as low as –10 in many parts of the country. These figures, representing unprecedented drought conditions for many States, prevailed throughout the fire season.

The near absence of rainfall last winter and spring and for much of the summer contributed to the decrease of moisture in both fine and heavy fuels and caused all fuels to be powder-dry and unusually susceptible to ignition. Not only did fires start more easily this season, but the extremely low fuel moisture, combined with low humidities and high temperatures, resulted in many fires burning hotter and spreading faster than normal. It is possible that the fire behavior triggered by this season's extreme conditions contributed to several of the fatalities suffered by the firefighting forces this year.

While requests for assistance from BIFC usually begin to build up in mid to late June, there was considerable fire activity throughout most of the Southeast during March, April, and part of May.

MAC Group Tested

Concern over the potential for a disastrous fire season and the early activity in the Southeast led the BIFC Directors to the decision to hold an exercise for the Multi-Agency Coordinating Group (MAC Group). This organization is formed when the fire situation gets so severe in so many geographic areas that there is doubt about the ability of the existing fire organizations to meet all the demands for fire resources.

When this occurs, fire management experts and logistic support specialists from a number of Federal agencies are brought in to augment the existing staff at BIFC. While there had been a "Mini-MAC" activated over the Fourth of July weekend in 1976, there had been no full-scale MAC Group in operation at the Fire Center since the severe fire season of 1973.

The MAC training exercise, conducted June 1 to 3 at BIFC, was designed and conducted by the National Interagency Training Center at Marana, Ariz., and by the personnel of BIFC's Division of Training. A fire simulation exercise was designed to test both organizational and operational capabilities.

While the earlier management philosophy was for the MAC Group to

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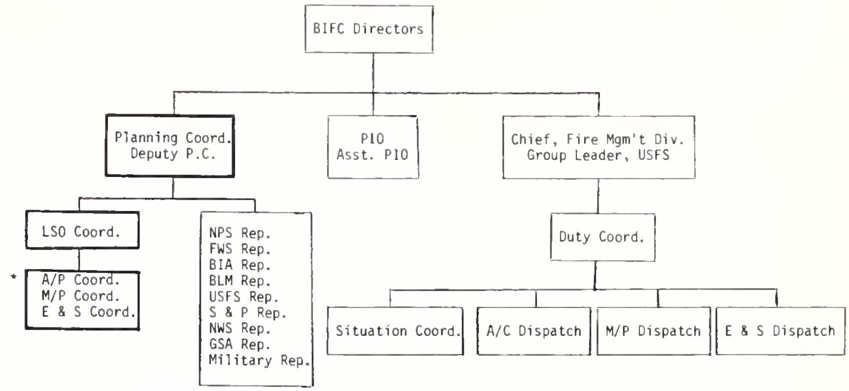
Mr. Hartigan is the Public Affairs Officer for the Boise Interagency Fire Center in Boise, Idaho.

supplant the BIFC Logistic Support Office, this exercise led to the recognition that multiagency coordination could best be utilized to augment the logistic support operation. The Line-of-Authority chart indicates the current organizational concept of the MAC Group.

By June, the fire activity was switching from the Southeast to the Southwest. At the same time, the Bureau of Land Management in Alaska was picking up the first indications of unusually high fire activities.

By the middle of June, the Intermountain and Pacific Coast States were beginning to develop fire activity on many Federal, State, and private lands. Fire activity continued to build until, by the first of August, there were major fires burning in 11 States. By this time, California and Alaska had become the focal points of the fire emergency; estimated statistics at the close of the fire season put the area burned in California and Alaska alone at more than 2½ million acres.

Lines of Authority - MACG Situation - PL IV



* Would continue to supervise their shifts on the dispatch desks.

= added to BIFC organization due to MACG Situation

= normal BIFC organization

MAC Group Activated

The fire situation had become so extreme that the BIFC Directors activated the MAC Group on August 3. The Group remained in operation for almost the entire month of August, gathering intelligence and advising the BIFC Directors on the setting of priorities for fire support and on the allocation of scarce resources.

Some of the scarcest resources included fire shelters and fire shelter covers. Fire crews were held at the BIFC staging area at times for 12 to 24 hours until they could be equipped with fire shelters. The Wichita, Kan., manufacturer of the shelters went on 24-hour-a-day shifts to produce the needed supply; 200 to 300 shelters a day were being received from the manufacturer by air. Crews were being immediately equipped and dispatched.

In several cases where there were enough shelters, there weren't enough shelter covers, and some crews went out with their fire shelters carried in lunch bags. All crews received instruction in the proper use of the fire shelters before being shipped to California and other western States.

August was a month of shortages. In addition to the fire shelter problem, there were shortages of fire-retardant Nomex trousers and shirts; radio communications networks; and cotton-jacketed, rubber-lined 1½-inch hose.

While there were short delays in supplying some of these items, most fire managers reported that the fire support system seemed to be working pretty well. The coordination efforts of the MAC Group and the Logistic Support Office in Boise, along with a similar Regional interagency group in California and the various dispatch and warehouse centers, helped fire managers anticipate some of the shortages and locate alternate supply sources or acceptable substitutes.

Fire Support Statistics

There were 34,166 fires reported to BIFC by all agencies through September 30. These burned a total of 3.36 million acres. In supporting a number of these fires, the Fire Center processed 3,625 fire orders. A total of 567 organized crews, or 11,340 firefighters, were processed through BIFC. Government aircraft flew 1,715 hours and hauled 25,749 passengers. The Logistic Support Office arranged 141 commercial aircraft charters and moved 17,445 personnel aboard these aircraft. The General Services Administration moved 3.15 million pounds of supplies during the 1977 season. Another 2.65 million pounds of supplies were shipped from fire caches and 1.76 million pounds from the BIFC warehouse.

BIFC's Communications Branch shipped the equivalent of 131 division radio kits to fires. In addition to the 567 organized crews processed through BIFC, 56 GHQ fire overhead teams were processed by the Center.

All of the figures aren't in yet, but it is already certain that 1977 will rank as one of the most severe fire seasons in recent years.

An Effective Rural Fire Reporting System

Lou W. Sloat

The dispatcher records a rural fire call, locates the fire on the block and grid map behind him, dispatches units in a matter of minutes.

Persuading the general rural public to report wildfires has been a continuing problem in many States. Texas, however, has developed a rural fire reporting system, utilizing telephone stickers, that could cause this longtime problem to become a minor factor during fire seasons.

How System Works

The telephone sticker rural fire reporting system works like this. Forest technicians with the Texas Forest Service make personal calls on rural residents in areas that have either been classified as a fire problem or that have a high incidence of fires. They deliver the stickers and explain the plan for their use. By meeting the landowners and rural residents on a one-to-one basis, the reception is increased many times beyond that of a program in which stickers are mailed out.

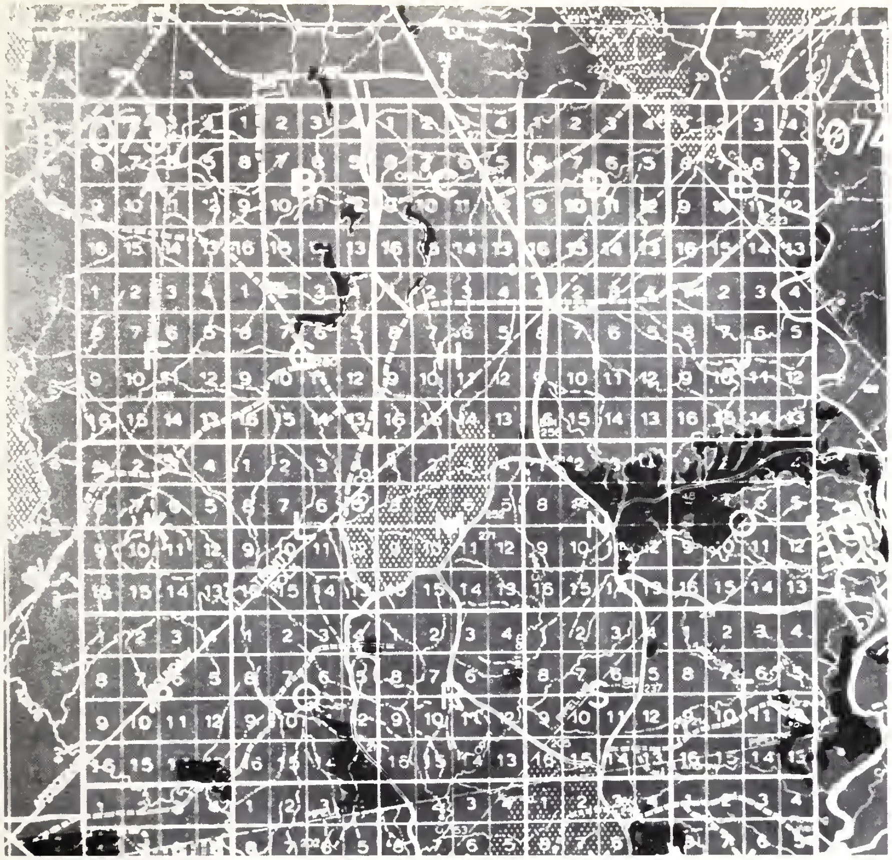
The telephone stickers have the block and grid numbers (similar to the range and township numbering system) of the area where that particular rural resident or landowner resides. It also has the fire dispatcher's phone number. The sticker has a gummed back, measures ¾ x 3¼ inches in size, and fits easily on the telephone receiver. When the person reporting the fire calls the dispatcher's office, he or she can give the exact location of the fire. This saves the firefighter valuable time in getting to the fire.

In cases where the landowner or rural resident is not at the exact location of the fire, he or she simply tells the dispatcher what his block and grid numbers are and where the fire is in relation to his location.

Since the Texas Forest Service uses planes rather than a fire tower detection system almost totally in fire detection, the aerial observer can usually confirm the location of the fire in a matter of minutes. In the past, rural residents reporting fires have been hampered with colloquial names of areas that were not necessarily familiar to the dispatcher or aerial observer. This system eliminates any doubt as to location, and reduces the chances of a firefighter going to a wrong location due to misunderstood directions or unfamiliar location names.

Public Reception

The questions that most people ask next are, "How receptive is the rural public to this system, and how effective has the system been in cutting down time consumed traveling



Each block of the Texas Forest Service block and grid system represents 16,000 acres or 25 square miles. Each letter grid covers 640 acres, while each number grid contains 40 acres.

to the fire's location?"

The public's reception has been almost 100 percent positive. In Texas, 46 percent of the fires are reported by the public. The time needed by direct reporting of the block and grid location by the telephone sticker program has been reduced to as much as half the time required if the sticker program had not been in effect.

Some might wonder how any organization could possibly contact all the landowners or rural residents within the 24 million acre protection area of the Texas Forest Service.

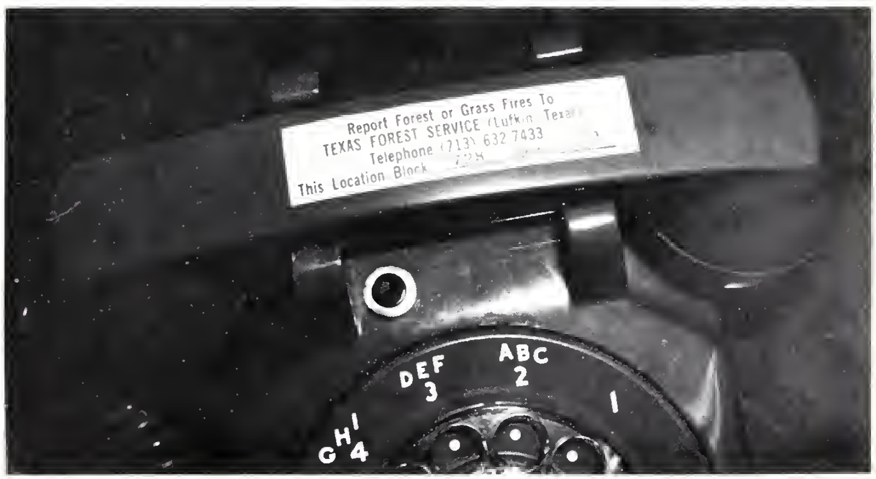
The solution is simple. Locations were plotted on a map showing where fires had occurred over the last several years. From these plottings, high incident areas were located. Priorities were then assigned for the rural contacts. Debris-burning areas were plotted, since many of the wildfires in Texas are caused by this factor. Areas that were known to have given the Service problems in the past were also plotted. From these plottings, fire reporting stickers were distributed to residents in the priority areas.

Block and Grid System Effective

If a State has no well-developed or established rural home identification program, the block and grid system, coupled with the fire sticker rural reporting program can be very effective. If a State is set up with another type of numbering system or a range and township grid system, the fire sticker rural reporting program can be easily adapted to that system.

The rural reporting system can be used with eitehr a computerized dispatching system or a phone dispatching system. The stickers are very economical to reproduce, and many messages can be fitted into the sticker's size and shape.

There may be other systems of a similar nature that work effectively, but for the Texas Forest Service, the telephone sticker program has worked well. Service personnel have developed a system that helps them save time, allows them to meet the public on a one-to-one basis to give them a fire prevention message, and effectively puts a simple reporting tool into the hands of the rural public for easier use in their rural wildfire reporting.



The telephone sticker is normally attached to the receiver. The block and grid numbers are right on the sticker.

Mr. Sloat is an area educator with the State of Texas Forest Service, stationed at Lufkin, Tex.

The Role of Aircraft Against Wildfires in Eastern North Carolina

B.A. Moore

A quick-hitting, initial attack force of large air tankers is a key element in the strategy employed by the North Carolina Division of Forest Resources against wildfires. This strategy is designed to stop a wildfire and keep it small until ground forces arrive to construct positive control lines. Small air tankers or, "snows," back up the large air tankers on first strikes and then are used for direct air-toground support and safety coverage for the ground forces.

Airports and Airstrips

The effectiveness of this program is critically dependent upon the enroute travel and turnaround time between the nearest retardant base and the fire site. To minimize response time, several airports or airstrips in eastern North Carolina are stocked with premixed retardant that is ready to be pumped into tankers quickly. Some of these bases are located at regular municipal airports. However, not all municipal airports are at the most desirable locations with respect to timber, values, and occurrence. To alleviate this problem, some of the paper companies have worked together to build several airstrips in strategic areas. These airstrips are usually 6,000 feet long and 150 to 200 feet wide. Therefore, in most areas, the Snow air tankers can operate within 15 miles of any fire.

Figure 1. — Snow tankers and lead plane work off an airstrip in eastern North Carolina, in the heart of a vast, low, dense pocosin area so rich in organic soil that "even the ground burns."

Figure 2. — A typical sod airstrip in one of many remote areas of North Carolina is stocked with water and fire retardant chemicals. Here, the DC-3 crew gets ready for operations. The van in at the left is a mobile air traffic control unit.

The Fleet

North Carolina's small air tanker operation consists of a DC-3, three Snow aircraft, and a T-34 lead plane. The DC-3 is the "mother ship" of the fleet and carries a loading crew, pumps, hoses, food, water, and extra fuel for the lead and scout planes. The fuel system of the DC-3 has been modified to allow 400 gallons to be pumped from the rear tanks directly into the tanks of the other aircraft. In emergencies, the system also allows fuel to be pumped from the two front main tanks.

When the Snow air tankers are dispatched to a fire, the DC-3 departs for the airstrip that has retardant capabilities closest to the fire. Immediately upon landing, the crew begins to prepare for operations. Among other duties, they set up the pumps and hoses to service incoming aircraft with retardant and fuel. At the same time, the DC-3 radio equipment begins to monitor both North Carolina Forest Service and VHF frequencies. This operation can continue for about 4 hours at full capacity without a break for refueling the DC-3.

The rugged Snow air tankers are able to haul heavy loads while operating off turf strips. They fly under turbulent conditions for years without failure. This leads the author to believe that their structural values are surpassed by few aircraft. The Snow air tankers are ideal for snags, spot overs, safety drops, close support for the tractors, and in some instances, line construction.

Mr. Moore is State Chief Pilot, Division of Forest Resources, North Carolina Department of Natural Resources and Community Development, Raleigh, N.C.

Snow air tankers hold a maximum retardant load of 300 gallons (except the "R" model, which has a 400-gallon capacity). With only 300 to 400 gallons with which to hit the target, accuracy becomes paramount. North Carolina developed a technique that, through practice and with constant lead, altitude, and airspeed values, allows the pilot to hit objects as small as a smoke pot or ground flare in most cases. This performance is a result of a great deal of training, coordination, and understanding created among the pilots of the lead plane and Snow air tankers.

The third aircraft of this team is the lead plane (T-34). The low wing design of the T-34 is ideal for lead plane work because it gives the pilot the ability to see the target and the incoming tanker while making steep turns. No other

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Fuel Mapping Helps Forest Firefighting in Southern France

Louis Trabaud

To estimate accurately the behavior of a wildfire and its probable extent, one has to observe the peculiarities of the different forest fuels, i.e., those of the vegetation itself. A vegetation map can provide this information. But to use such a map, a firefighter needs an accurate indication of the complexity and the spatial distribution of the vegetation. This information can best be displayed on a large-scale map. For this reason the "forest fuels map" of Herault County (625,000 ha) was prepared at the 1/25,000 scale. Herault County is in southern France and situated on the Gulf of Lion of the Mediterranean Sea.

The detailed description of the forest fuels is becoming increasingly necessary. Application of the results of these studies is needed to solve practical problems, such as firefighting and fire damage appraisal.

Forest Fuels

Forest fuels are collections of plants and plant parts which have definite shape and composition, depending on the plant qualities and the environment. A plant is made up of different parts or organs such as stalks or trunks, leaves, barks, thorns, buds, flowers, roots, etc. These different parts, alive or dead, are flammable components of different shapes and sizes. This assembly can be called a fuel complex (Brown 1970).

Several physical characteristics of fuels, such as the size of the particle, its weight, and its position in the space, affect fire behavior. These are characteristics which determine the ignition probability, to rate of spread, and the intensity of a fire. A firefighter needs to evaluate these characteristics in order to fight forest fires effectively.

Survey Methods

There are two operational methods used to survey the vegetation (Trabaud 1973). First preliminary photointerpretations should be made on panchromatic and infrared aerial film. These permit homogeneous vegetation to be outlined or stratefied.

Work must then be done in the field to make a detailed record of the vegetation in each area, so the outlines can be corrected if necessary.

Once the forest stands are identified and outlined in the field, the next step is to describe the different kinds of fuels.

Kinds of Fuels

The principal kinds of forest fuels are:

- *Litter.* This is composed of humus and duff, dead leaves, mosses, lichens, and dead twigs.

Humus and duff play a minimal role as fuel in the Mediterranean forests due to their state of decay and shallowness.

The dead leaves are highly flammable when they are dry. This is particularly true for the needles of the softwoods, which form a loose carpet which is easily ignited. Mosses and lichens become flammable during dry periods. The dead twigs, once ignited, also contribute to fire spread.

- *Herbaceous layer.* The grasses, ferns, and forbs make up this layer. The herbaceous species are a hazardous fuel during droughts, particularly if the herbaceous layer is dense and continuous.
- *Low woody species layer.* This is comprised of scrubs, underwood, shrubs, and low trees less than 2 meters high. This layer is particularly important in fire behavior. A "fuel ladder" exists when this layer is continuous and when the fuel mass is high. The "ladder fuels" trigger crown fires.
- *High woody species crown layer.* In this layer there are several strata made by the branches and the foliage of the trees taller than 2 meters. Although not ignited initially, this fuel layer has a major influence on fire behavior and consequently on firefighting. As soon as a fire reaches the tree crowns, it finds the largest quantity of fuels to burn. As a result, the fire will spread rapidly, and firefighting becomes most difficult.
- *Dead wood and snags.* These fuels constitute a separate category. The accumulation of dead wood by natural fall, the slash, and the snags caused by diseases or lightning strikes are highly dangerous fuels. These fuels favor

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Mr. Trabaud is a Research Scientist with the Centre d'Etudes Phytosociologiques at Ecologiques Louis Emberger, Montpellier-Cedex, France.

spot fires which are ignited by glowing wind-borne embers that come from them.

Fuel Arrangement

After recognizing the different kinds of fuels, it is necessary to examine their horizontal and vertical arrangement. It is also necessary to describe the stands both in terms of the vegetation and the topography.

To do this, four basic concepts must be considered. First, there is the structure of the vegetation. This structure corresponds to the spatial arrangement of the different parts of the plants. It is essential to know these characteristics in firefighting because of their effect on the rate of spread and the kinds of spread of ground fires, surface fires, and crown fires.

It is necessary to estimate the phytomass which governs the fire intensity. A "biovolume index" has been developed to estimate the total volume of plant material which can be burned if a fire goes through a forest stand.

A determination must be made of the dominant species which characterize the forest stand owing to their index of cover or their mass and their flammability can influence fire dynamics and behavior.

Finally the ease of firefighting (resistance to control) must be considered. These four concepts are the criteria which characterize each stand from the point of view of firefighting operations.

Fuel Structure

The structure is characterized by the forest stand types and the stratification of the vegetation (Godron et al 1968). With regard to the forest stands, 11 basic classes were distinguished according to the dominant types of plants. (table 1). These are:

- five simple forest stands made up of one dominant type of plant (LHd, LHac, Lhc, LB, H)
- four complex forest stands made up of several dominant types of plants (LHB, LHH, LBH, LHBH)
- an eroded class, characterized by a very sparse plant cover (ZE)
- areas without vegetation such as quarries, spoil-dumps, etc. (ZN)

As described above, fuel layers are the litter, the herbaceous layer, the layer of low woody species (<2m), and the layers of the high woody species (>2m). A system using symbols helps distinguish the different layers of the high woody species. The layers are 2-4 m, 4-8 m, 816m >16 m.

Biovolume Index

The biovolume index represents the total volume of fuels of a given stand which is apt to burn during a fire. This index is arrived at by determining the sum of the percentages of the coverage of each fuel layer in a parallelepiped (a prism whose bases are parallelograms) in which all vegetation would be enclosed. If the vegetation fills the parallelepiped, the biovolume index equals 50. If the plant diminishes, the biovolume index diminishes, too (fig. 1)

The main species in each stand are noted by means of appropriate symbols. To facilitate reading the map, the high woody species are represented by two capital letters; the low woody species by a capital letter and a small letter; and the herbaceous species by two small letters. In the legend the species are listed according to their decreasing importance.

The estimation of eas of firefighting is based on three factors — accessibility, movement, and penetrability.

Accessibility (symbol A) is the possibility that a vehicle can normally reach the described area. The area is accessible if there is a road or a trail in the vicinity of the area. If a vehicle cannot have access to the area, the distance from the road to the area shall

Continued on next page

Forest stands unities		Percent cover of high woody species	Percent cover of low woody species	Percent cover of herbaceous species
Dense high woody species stands	LHd	75-100	0-100	0-100
Fairly open high woody species stands	LHac	50-75	0-100	0-100
Very open high woody species stands	LHc	25-50	0-10	0-10
Low woody species stands	LB	0-25	10-100	0-10
Herbaceus species stands	H	0-25	0-10	10-100
High woody and low woody species complex stands	LHB	25-50	10-100	0-10
High woody and herbaceous species complex stands	LHH	25-50	0-10	10-100
Low woody and herbaceous species complex stands	LBH	0-25	10-100	10-100
High woody, low woody and herbaceous species complex stands	LHBH	25-50	10-100	10-100
Areas with sparse vegetation	ZE	0-25	0-10	0-10
Areas without vegetation (mines, quarries, etc.)	ZN	0	0	0

Table 1. — Characterization of forest stands.

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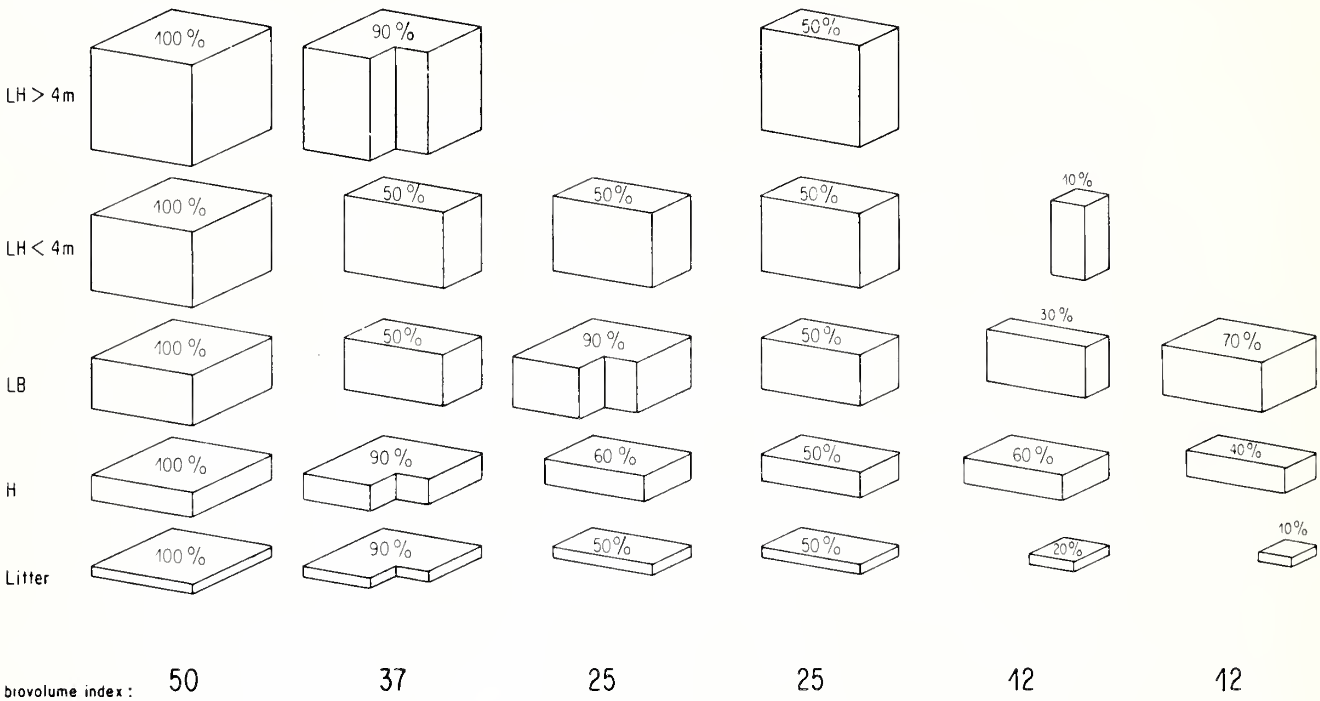

Figure 1. — Representative examples of the flammable viovolume index and its distribution according to the different layers.

not be longer than 50 meters. If longer, the area is considered inaccessible.

Movement (symbol M) corresponds to the possibilities that a ground vehicle has to move in the area. The area is "not rugged" when a fourwheel-drive vehicle can move in. The area is "rugged" when there are rocks or obstacles of any kind which hinder the progress of a four-wheel-drive vehicle.

Penetrability (symbol P) is the possibility that a person on foot can walk into the area or the stand. A stand is "penetrable" when a person can open up a path using only his hands. If the person has to use mechanical means, such as a chain-saw or brush-cutter, to open up a path, the stand is considered as "impenetrable."

The different combinations of the ease of firefighting are symbolized at the end of the legend by Roman numbers from I to VIII, according to the decreasing difficulties encountered in the field. These different possibilities are labelled in table 2.

On the map additional information is shown as young afforestation (plantations) (R), helispots (H), and new residential areas (L).

Figure 2 shows several examples of how the symbols are used.

For example the symbol "LHd 9, 31, DG, pt, III (R)" means that there is a dense, high woody species stand (forest); the trees are higher than 16 meters; the biovolume index is 31 (important), the main species are Douglas-fir (*Pseudostuga menziesii*) and bracken fern (*Pteridium aquilinum*); the stand is accessible for a vehicle, but obstacles for vehicles are present; and the stand is a plantation.

The information shown on the large-scale maps of the forest fuels helps the firefighter analyze very quickly the fire situation while taking into account the local weather and topographic conditions. This infor-

I	**AMP**	**All the operations are possible in the stand**
II	**AMP**	**Accessible and not rugged stand, but penetration is difficult (rarely seen)**
III	**AMP**	**Accessible and penetrable stand, but obstacles for vehicles are present.**
IV	**AMP**	**Accessible area, but bad conditions for firefighting**
V	**AMP**	**Stand with difficult access, but favorable to firefighting**
VI	**AMP**	**Stand with difficult access and difficult penetrability, but four-wheel-drive vehicles can move in the stand (rarely seen)**
VII	**AMP**	**Stand with difficult access and obstacles for a four-wheel-drive vehicle, only man can walk in**
VIII	**AMP**	**Inaccessible stand in all respects**

Table 2. — Ease of firefighting (all possibilities considered).

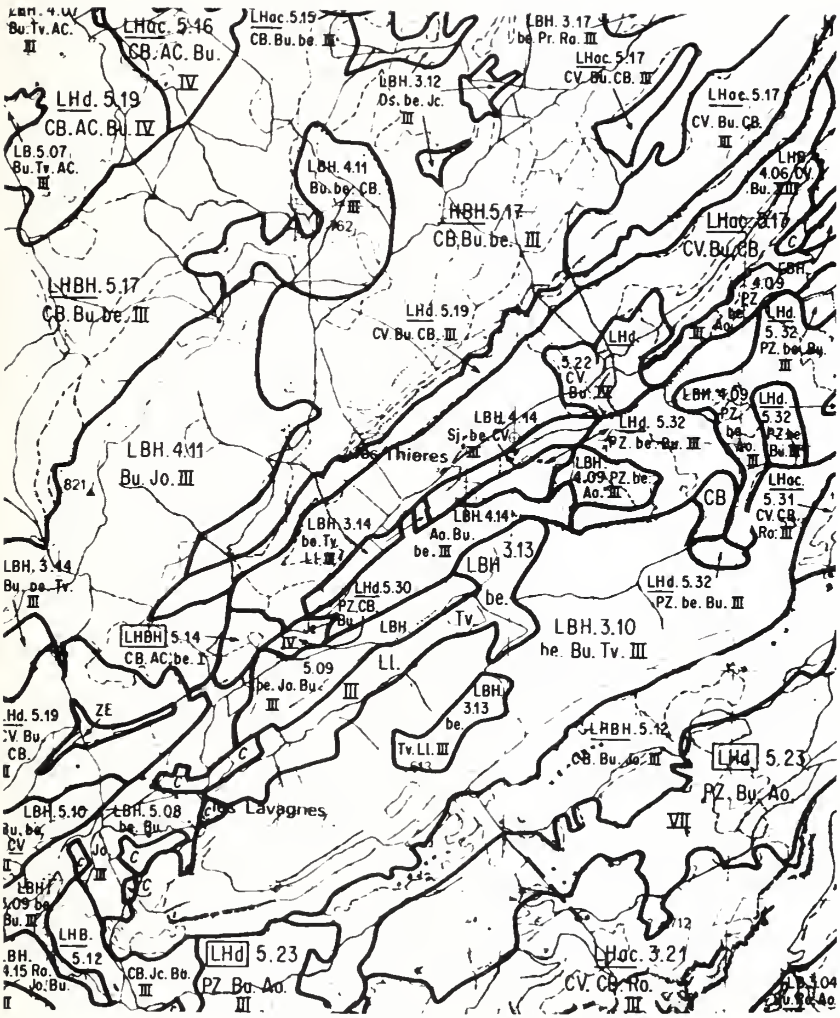

Figure 2. — Sample of the forest fuels map of Herault County, France.

mation allows the firefighter to optimize the selection of people and equipment, and thereby fight and control the fire efficiently.

This flexible kind of cartography can have different degrees and scales of utilization. The mapping system describes objectively the natural complexity of the vegetation and can be easily applied to areas other than Herault County, France. Two other areas have been surveyed in the same manner in southern France — the Alberes in the eastern Pyrenees and the Golo Valley in Corsica.

The interpretation of structural and vegetative elements of each described area on the maps permits a better appraisal of the fire phenomenon either by an estimation of the global fire danger for a year (Amandier 1974; Trabaud and Allag 1976) or by an estimation of the fire danger by seasons (Etienne 1976).

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ROLE OF AIRCRAFT

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Figure 3. — A Snow tanker drops a load of retardant on a fire in eastern North Carolina.

single engine aircraft is better suited for this work, in the author's experience. However, this author is certain that its performance would decline in mountainous terrain.

Which Tankers are Best?

Over the years, the merits of large tankers versus small tankers have been widely discussed. The needs of other areas may favor large or small tankers. However, in North Carolina, there is a definite need for both. When working on a fire, there is a comforting feeling to see three Snow air tankers orbiting nearby, just waiting for a spot over, or to give close support to the ground units. Moreover, who can afford to do much orbiting with large tankers at today's prices? On the other hand, the large tankers are a key element in the initial attack. In North Carolina's overall strategy against wildfires, both sizes of air tankers play a critical role under the conditions in the eastern part of the State. The DC-3 and T-34 fill the remaining requirements for initial attack and support from the air to achieve the quickest and most effective control of wildfires.

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The Changing Role of Fire Management

Lynn Biddison

In the Southwest Region of the Forest Service (Region 3), fire management has become much more than just suppression of wildland fires. It includes those activities involved with fire prevention and presuppression and with fuels management as well as fire suppression.

The Forest Service, through its recent response to the Forest and Rangeland Renewable Resources Planning Act, has become committed to doing a total fire management job. In Region 3 this committment could not be met until we implemented our 1972 fire plan.

Fire History

National Forests and National Grasslands in New Mexico and Arizona cover approximately 22 million acres. They average more fires each year than any other Region of the Forest Service, with over 2,800 fires occurring annually during the period from 1970 to 1977. In 1977 there were 2,706 fires in the Region. It has the second highest average burned area—45,000 acres per year.

A report about the Southwest, which was prepared by the Pacific Southwest Forest and Range Experiement Station in Berkeley, Calif., included a statement that critical fire weather occurs with greater frequency and persistence in this part of the country than in any other. The critical season is practically year around with an annual minimum in winter months and a secondary minimum in August.

Large fires in the spring and fall characterized the fire history of many of the Region's National Forests. In the spring the fires are usually on the southern National Forests and usually occur before May 15. Prior to the implementation of the 1972 fire plan, this was the date set for the normal activation of the fire suppression organization. In the fall the losses are often in the northern National Forests and occur after the short rainy season of the summer.

Management Challenges

In Region 3, as in other areas of the country, fire managers and land managers are faced with many challenges. There are vast areas with high volumes of available fuels. For many years management activities have been creating fuels which were not treated. Logging debris that was created 30 to 50 years ago has been the primary fuel of several large fires.

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Mr. Biddison is the Director of Fire and Aviation Management for the Forest Service's Southwestern Region, Albuquerque, N. Mex.

CHANGING ROLE
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The Region has a backlog of over ½ million acres of untreated activity fuels. Newly created activity fuels have been treated currently during recent years. Treated areas have averaged almost 191,000 acres per year. Naturally occurring fuel accumulations are also adding to the challenges.

The established Region 3 fuels management goals for the 5-year period from 1977 through 1981 are:

1. To treat all of the slash disposal backlog of over ½ million acres by 1980.
2. Through coordinating efforts, to seek opportunities to use prescribed fires on 4 percent of the ponderosa pine acreage on each National Forest.

There are approximately 4.8 million acres of commercial ponderosa pine in the Region.

In addition to these fire management challenges, there are others. Many National Forests have thousands of homes and other improvements intermingled with the forest areas. The area of the world's heaviest lightning concentration is within the Region along the Mongollon Rim. Dispersed recreation use is very heavy. This and other uses of the National Forests result in a serious fire problem.

Fire Planning

The fire planning effort accomplished in 1972 and 1973 demonstrated that the numbers and kinds of fire suppression forces available were inadequate. The employees available for fire suppression were almost all hired on a seasonal basis. The resulting high turnover constituted a constant training challenge. Another result of this problem was very little accomplishment in any area of fire management except in fire suppression.

Managers were faced with an important question: What action has been taken to meet and solve these challenges?

The 1972 fire plan identified the tasks to be done and the organization needed to accomplish the work. Implementation of the fire plan began in 1973. The results have been gratifying.

The tenure of fire management personnel has increased. This has resulted in more highly trained people to do the job. Their performance has also improved. For example, Regional "hot shot" crews have consistently produced 25 percent or more fire line per shift than was originally anticipated. Their production has proven to be 50 percent greater than the organized crews previously used throughout the Region.

Improved Safety

The safety record has likewise improved. The record of "hot shot" crews versus organized crews on fire suppression assignments is significantly superior. In 1976, 14 "hot shot" crews experienced only 5 occupational injuries while on fire suppression operations. This record was made despite an extremely heavy fire season.

Improvements have also occurred in fire prevention, detection, reporting and suppression for all periods of the year. The most significant changes have been noted in the spring and fall.

The availability of trained, highly qualified Forest Service firefighters has strengthened and improved the partnership between the Forest Service and wildland fire suppression agencies within the U.S. Department of the Interior and State governments.

Preattack planning accomplishments have increased. This planning effort has become the cornerstone for the prescribed natural fire program within the Gila Wilderness. Many other fire management activities hinges on this planning as well.

Improved fire management activities have resulted in a reduction in the resource losses and suppression costs which had been occurring prior to and after the activation of short-term seasonal fire organization.

Fire management personnel are now available to participate in land management and other types of interdisciplinary planning.

Finally, Regional performance has improved in meeting and solving the fuel management problems. From 1973 to 1977 fuel management accomplishments in Region 3 increased eightfold — from 6,000 acres per year to 50,000 acres.

The fuels treatment accomplishments are made possible partly because of a stable fire organization. The stability of the organization is needed to meet the suppression needs as well as meeting the needs of firerelated project work. This is well illustrated by a report from the Coronado National Forest, which,

although submitted in 1976, is still valid:

One of the primary goals of fire management on the Santa Catalina Ranger District is the reduction of excessive amounts of fuel by prescribed burning. There are approximately 32 thousand acres of pine type on top of the Catalina Mountains; and due to private land, summer homes, electronic installations, and recreation all prescribed burning must be carefully controlled.

From August 1 to September 10, 1976, the Catalina Hot Shot Crew spent 167 man days in site preparation for the prescribed burning of 751 acres. Organization Ridge, where the Boy Scouts, Girl Scouts, LDS, Presbyterians, Methodists, and Baptists have their summer camps, was the first priority fuel reduction and is included in the 751 acres. This work was primarily handline location, construction, and water barring. In addition, fuel loading transects were located throughout the area, as well as photo points. Slope class for the area is 3, fuel model C, and fuel loading varies from 25 to 80 tons per acre.

During the same period, the Catalina Hot Shot Crew was used on six lightning fires on their District, plus a BLM fire in the Harcuvar Mountains and a National Park Service fire in Grand Canyon. At present, they are leaving for a fire in Minnesota.

Their availability from August 1 to date has resulted in complete on-the-ground site preparation for the highest priority prescribed burn on the District. The fuel inventories, handlines, and photo points will enable the District to do a high quality, complete prescribed burn.

Without the Catalina Hot Shot Crew, the Coronado would not have been able to accomplish the fuels management and fire prevention and presuppression work. Other units in Region 3 have reported similar experiences, since the same procedures and results are being used regionwide. This type of work is in keeping with National and Regional direction to lower the flammability of all National Forest lands. Without today's fire management organization, this work would not be accomplished. Without the work there would be an increase in resource losses and suppression costs.

Changing Focus

In Region 3 fire management is indeed changing from a focus on fire suppression to one of equal emphasis on suppression, detection, presuppression, prevention, fuels management, and land management planning. The leadership role for this broadened program must be redeemed by the same people who had the leadership of the suppression-oriented program. To do this we must move from a part-time program to one that is year around in order to redeem our responsibilities for fire management in its broadest context.

The Management Review System: A Means of Achieving Commitment to Fire Management Programs

Billy Page

Forest Service fire management activities are in a process of evolution, and their interface with other land use activities are mandatory in achieving overall land management goals. The result is a need to develop more areas of expertise within the fire management ranks.

There must be an increased emphasis on keeping other personnel advised of the latest developments. Line and staff officers at the National Forest and Ranger District levels must keep abreast of these changes in fire technology and understand how fire's role can be integrated into the land management process.

Commitment Needed

The first step to assure that this will come about is a commitment by these field officers to operate fully coordinated, efficient, and resourceful fire management programs. The Management Review System, implemented by the Forest Service in 1975, is an excellent tool for increasing both line and resource staff involvement in fire management programs and for improving commitment through better understanding.

Mr. Page was the Fire and Information Staff Officer of the Ozark-St. Francis National Forest in Russellville, Ark. Currently, he is attending Colorado State University under a Forest Service sponsored graduate program in fire management. He lives in Fort Collins, Colo.

The level of commitment to the management of fire varies considerably from unit to unit. Commitment, or a lack of it, can usually be traced back to the responsible line officer. If the line officer has a firm commitment to the fire management program, you can expect a strong fire organization operating on that unit. Conversely, if the commitment is weak, the fire organization on that unit will be operating in a subjugated role. Lack of commitment often results from a relatively low level of understanding of fire science and management by line officers and by key staff personnel.

Line Involvement

The Management Review System can be utilized in reinforcing or improving commitment in several ways. Most importantly, the System requires direct involvement of the line officers in the review process, specifically the Forest Supervisor and the District Rangers.
These officers must approve the sequential steps that will be followed in the review process. Secondly, the System stresses the interdisciplinary approach in review-team building. Key staff officers, having limited exposure to fire management activities, can benefit by assignment to the team. Usually, as understanding increases, so does commitment.

Action Plan

Alternative solutions must be developed for problems identified during the review. This development of alternatives has a beneficial effect on team members by forcing them to explore several possibilities in solving a problem. This, consequently, helps to increase each team member's understanding of the role of fire management in land or resource management.

While constructing the action plan, the line officers involved at both levels must analyze these alternatives. This is a critical step in the review process. It provides an opportunity for the line officer to look at the whole array of fire programs or activities under review. Objectives can be reemphasized and unclear segments clarified. Priorities can be set. Areas of disagreement will be highlighted and thoroughly discussed, with appropriate staff input, to arrive at a common understanding.

The ultimate purpose of this exercise is for the Forest Supervisor and the subordinate line officer to agree upon a firm course of action. Assumptions and doubts are cleared away in favor of a clear understanding regarding what is to be accomplished. Commitments are made. Lines of communication are opened. People are motivated.

Finally, the Management Review System provides for the timely completion of required actions in problem areas. Completed work must be certified in writing by the line officer whose unit was reviewed. Accountability is enhanced.

The Forest Service approach to the Management Review System does not include designated specific intervals for conducting reviews. The forest fire management program must be carefully monitored to detect review

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needs. A proper balance of scheduled reviews may help to correct deficiencies without causing undue interruptions in ongoing programs or incurring excessive costs.

Keep in mind that reviews are not scheduled solely because someone's responsibilities have not been fulfilled. Changes in direction for resource management affecting a particular area may dictate a fresh look at existing policies and procedures regarding the role of fire in land management. A District Ranger may even request a review to better identify needs and priorities, so that a better mix of fire management activities can be designed and implemented.

In Summary

The forest fire management staff officer has a key role in the review process. One of the responsibilities is to monitor the fire management program for overall effectiveness. If problem areas are spotted, one alternative is to recommend utilization of the Review System to correct these problems. The Forest Supervisor must agree that a review is needed and should be the one that officially initiates the review. Costs and benefits must be considered. Management reviews are expensive with minimum costs ranging from $2,000 to $3,000.

The Management Review System of the Forest Service has three overriding features:

- the requirement that line officers actively participate.
- the development of alternatives for solving problems.
- the opportunity to use the System as a training device.

When the System is utilized astutely by fire management personnel, the results should be an increased understanding of fire management's role in resource management, and consequently, a greater commitment to the fire management programs.

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